

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 081 963 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.03.2001 Bulletin 2001/10

(51) Int Cl.7: H04N 7/64

(21) Application number: 99306911.1

(22) Date of filing: 31.08.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(72) Inventor: Eryurtlu, Faruk Mehmet Omer
Swindon Wiltshire SN2 3FW (GB)

(74) Representative: Williams, David John et al
Lucent Technologies UK Limited,
5 Mornington Road
Woodford Green, Essex IG8 0TU (GB)

(71) Applicant: LUCENT TECHNOLOGIES INC.
Murray Hill, New Jersey 07974-0636 (US)

(54) Video signal error detection systems

(57) Mobile phones now transmit video signals to each other. Such video signals are transmitted at a relatively slow bit rates. The signals transmitted are compressed using inter-frame prediction where sufficient similarity exists between successive picture frames. The receiver includes a decoder (18) which acts to re-constitute the compressed signals received using signals stored on a buffer (22) representing a previous picture frame. A mode decision circuit (24) compares the signal at the output of the decoder (18) with the previous

signal stored in the buffer (22) and using the same decision criterion as used for the original compression generates a signal which indicates that either the signal is suitable for inter-frame prediction or not. This signal is then compared in a comparator (26) with the signal in the decoder (18) indicating whether or not the current signal was inter-frame predicted or not. If equality is not detected, then an error may have taken place. Then, error concealment techniques can be used to reduce the effects of the errors.

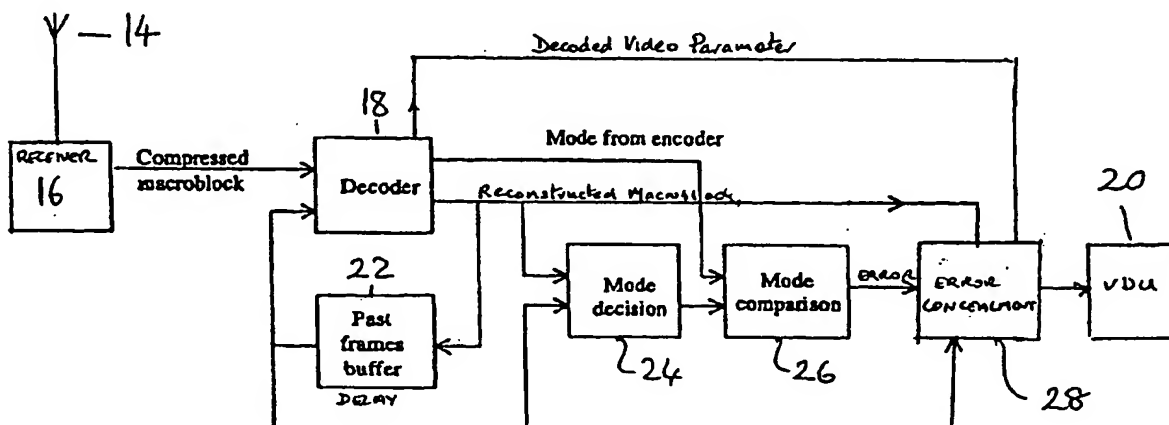


Fig 2

Description

[0001] The present invention relates to video signal error detection systems.

[0002] Mobile phones now have the facility to transmit and receive video signals so that the communicating parties can view each other while speaking.

[0003] Because of restricted bandwidths, the signals are transmitted at low bit rates. Because mobile phone networks are now so extensive and the transmission medium is air, the transmitted signals are more susceptible to corruption, for example, due to channel errors. Accordingly, there is a need to check received video signals for errors.

[0004] The video signals are usually transmitted in a succession of successive macroblocks. Each macroblock may comprise a block of 16 x 16 pixels of a picture frame. A simple error check may be carried out in the mobile phone receiving the signal, by counting the coefficients in the macroblock. In a 16 x 16 macroblock there will be a maximum of 256 coefficients and, if more are counted, it can be assumed that an error has occurred. In this event, the macroblock being received may be suppressed and replaced by the corresponding block in the previous frame or other error concealment techniques may be used.

[0005] However, other errors may not be so easy to detect.

[0006] It is an object of the invention to provide an improved video signal error detection system.

[0007] According to the present invention there is provided a video signal error detection system for use in a receiver having a decoder for receiving encoded video signals produced by an encoder in a transmitter, the encoder being selectively operative to transmit only differences between selected macroblocks in successive frames when a specific difference criteria between said successive blocks is not exceeded, the detection system comprising a first comparator for comparing macroblocks in successive frames in the output signal from said decoder, applying said specific difference criteria to provide an indication of whether inter-frame prediction should apply or not, and a second comparator for comparing the output from the first comparator with an output from the decoder indicative of whether or not the last macroblock received was in inter-frame prediction format or not and operable to generate an error signal when a divergence is detected.

[0008] The video signal error detection system embodying the present invention, will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a block diagram of a video transmission system; and

Figure 2 is a block diagram of a video reception system.

[0009] The video transmission system shown in Figure 1 comprises a video camera 2 which generates a video output signal representative of a picture frame.

[0010] The output of the camera 2 is fed to an encoder 8. The output of the encoder 8 is fed via a delay circuit 4 to a buffer memory 6 and directly to a transmitter 10 which transmits the signal via an antenna 12 to a remote station. The encoder 8 compares the current picture frame signals being received from the camera 2 with the immediately preceding picture frame signals as stored in the buffer memory 6.

[0011] The encoder 8 exploits the correlation between successive frames. The current video coding standards use block matching motion compensation technique for inter-frame prediction. In this approach, if the current picture block is similar to another block in the previous frame (picture) within the search area, the displacement (motion) vector and the difference between those two blocks are encoded (INTER mode). Otherwise, the current picture is encoded without any inter-frame prediction (INTRA mode).

[0012] Each block, hereinafter called a macroblock, may comprise a 16 x 16 pixel block.

[0013] The video reception system, shown in Figure 2, includes an antenna 14 which feeds a receiver 16. The output of the receiver 16 is fed to a decoder 18. The decoder 18 decodes the bit stream which also includes a mode indicator signal from the receiver. This mode information is fed to a mode decision circuit 24. The reconstructed picture is fed to an error concealment circuit 28, and also to a buffer 22 so that the buffer 22 is always updated to provide the previous (the immediately preceding) picture frame.

[0014] The output of the error concealment circuit 28 is displayed on a visual display unit (VDU) 20.

[0015] The mode decision circuit 24 responds to the output of the decoder 18 and the buffer 22 to carry out a similar decision making process to that carried out in the encoder 8 ie it tries to predict whether the two macroblocks being compared qualify for INTER or INTRA mode treatment. A comparison circuit 26 then compares the output of the decision circuit with the mode indicator from the decoder 18. If concordance is not detected, there is a strong possibility of error. The error concealment circuit 28 tries to recover corrupted data if an error indication is signalled from the comparison circuit 26, using established techniques.

[0016] The mode decision circuit 24 may be constructed in a manner similar to the video codec test model Version 8 (TMN8) described by Thomas R Gardos in the proceedings of the video coding experts group question 15 (Q15-A-59) Portland 24-27 June 1997, which material is incorporated herein by reference.

[0017] In TMN8, the following parameters are calculated to make the INTRA/INTER decision:

$$MB_mean = (\sum_{i=1, j=1}^{16,16} original(i, j)) / 256$$

$$A = \sum_{i=1, j=1}^{16,16} |original(i, j) - MB_mean|$$

INTRA mode is chosen if $A < B$

Where,

$$B = \sum_{i=1, j=1}^{16,16} |original(i, j) - previous(i, j)| - \beta$$

$$\beta = \begin{cases} 600 \text{ mv} & \text{if } 0 \\ 500 \text{ mv} & \text{if } \neq 0 \end{cases}$$

[0018] The parameter *previous (i,j)* corresponds to the best match block in the previous frame used for motion compensation, and *mv* is the motion vector.

[0019] Since the decoder does not have the original values, the term "original" has to be replaced by the term "reconstructed". The change from two-outcome to three-outcome case is achieved by considering an error margin *E* due to the problems discussed above:

INTRA mode if $A < B - E$
UNKNOWN if $B - E < A < B + E$
INTER mode if $B + E < A$

[0020] A mode change from INTER to INTRA (or vice versa) indicates that the current block is corrupted, and therefore appropriate error concealment techniques should be used, such as the one hereinbefore described.

[0021] Obviously, the value of *E* should be tuned depending on the system in use. It is a trade-off between the accuracy and rate of detection of the corruption blocks. If the decoder and encoder both employ the same method for mode selection, then a smaller *E* can be selected.

[0022] The difference between the original and decoded pixel values depending on the quantization parameter *q*. Therefore, *E* should be a function of *q*. This function should be determined by considering the quantizer. For the TMN8 quantizer, *E* value is defined as follows:

$$E = \begin{cases} 256 & \text{if } q < 4 \\ 64q & \text{if } q \geq 4 \end{cases}$$

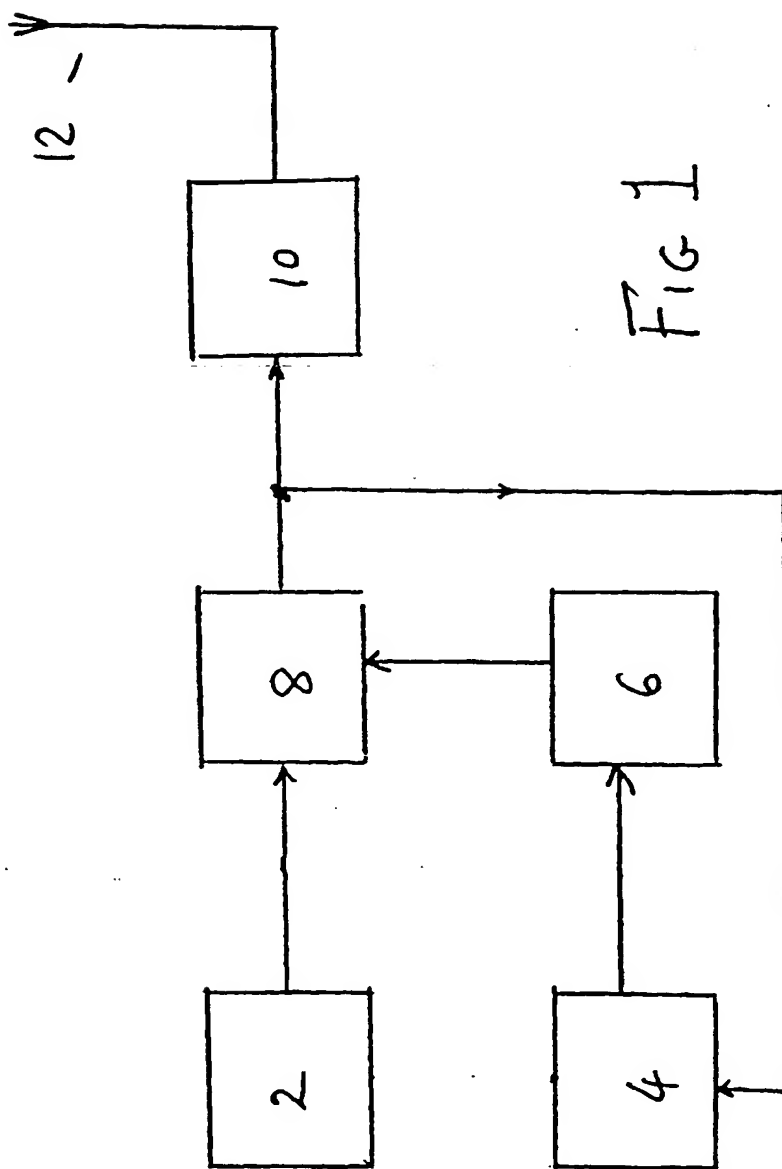
Claims

1. A video signal error detection system for use in a receiver having a decoder for receiving encoded video signals produced by an encoder in a transmitter, the encoder being selectively operative to transmit only differences between selected macroblocks in successive frames when a specific difference criteria between said successive blocks is not exceeded, the detection system comprising a first comparator for comparing macroblocks in successive frames in the output signal from said decoder, applying said specific difference criteria to provide an indication

EP 1 081 963 A1

of whether inter-frame prediction should apply or not, and a second comparator for comparing the output from the first comparator with an output from the decoder indicative of whether or not the last macroblock received was in inter-frame prediction format or not and operable to generate an error signal when a divergence is detected.

- 5 2. A system according to Claim 1, including an error concealment circuit responsive to the output of the decoder and buffer to recover corrupted data when the second comparator indicates an error.
3. A system according to Claim 1 or to Claim 2, wherein the first comparator acts as a mode decision circuit capable of generating one of three outcomes namely, inter-frame prediction, no inter-frame prediction and unknown.
- 10 4. A system according to Claim 3, wherein the mode decision circuit responds to each macroblock of each frame from the output from the decoder to determine a mean value for the pixels and responds to the difference A between the reconstructed values of the pixels in said macroblock and the said mean value, the difference B between the reconstructed values of the pixels of the present macroblock and the reconstructed values of the pixels of the
- 15 corresponding macroblock of the immediately preceding frame and the error margin E to provide a first outcome if $A < B - E$ a second outcome if $B - E < A < B + E$ and a third outcome if $B + E < A$.
5. A system according to Claim 2, wherein the error concealment circuit acts to replace each corrupted macroblock with a corresponding macroblock in the immediately preceding frame.



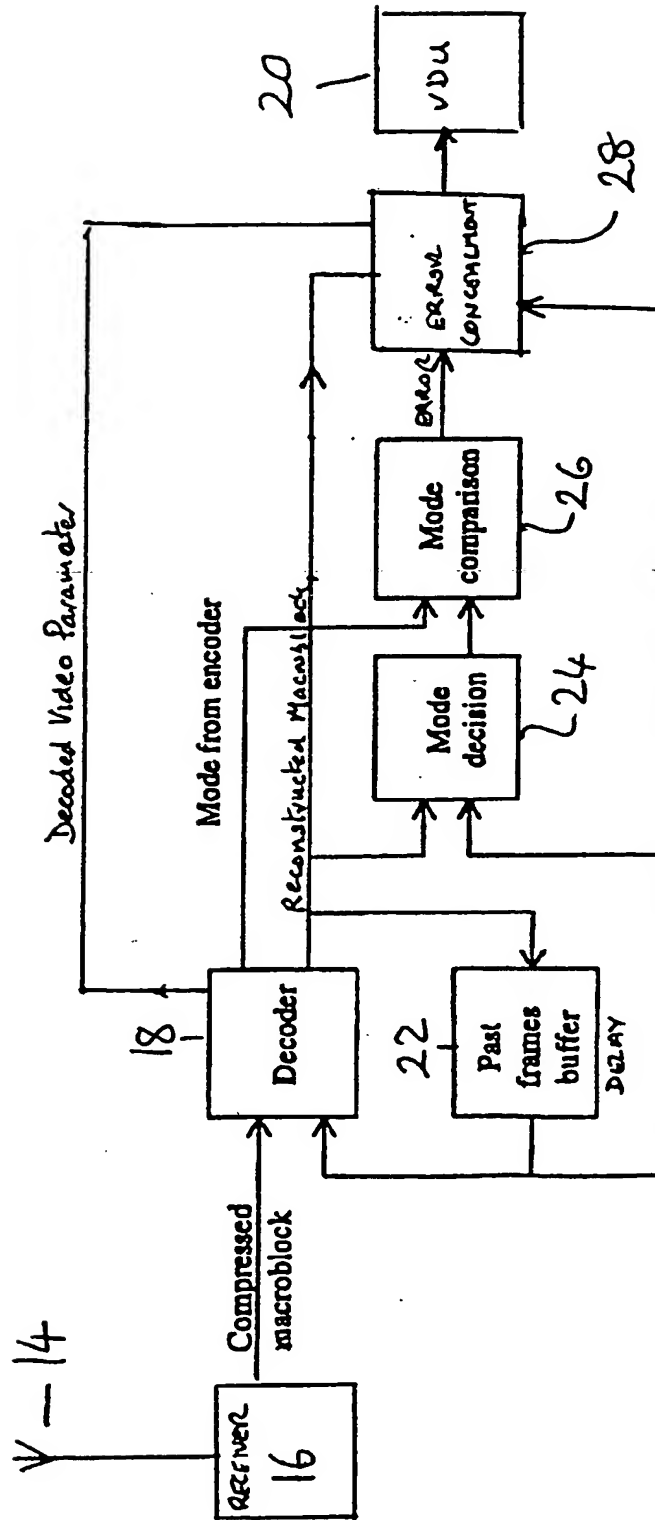


FIG 2

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 6911

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL.7)
Y	US 5 488 618 A (KONDO TETSUJIRO ET AL) 30 January 1996 (1996-01-30) * the whole document *	1-5	H04N7/64
Y	US 5 627 590 A (SAKAI KIYOSHI ET AL) 6 May 1997 (1997-05-06) * column 4, line 40 - line 60 * * column 6, line 17 - line 53 * * column 7, line 8 - line 21; figure 5A *	1-5	
A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 429 (E-0978), 14 September 1990 (1990-09-14) & JP 02 166892 A (MATSUSHITA ELECTRIC IND CO LTD), 27 June 1990 (1990-06-27) * abstract *	1-5	
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 267 (E-1217), 16 June 1992 (1992-06-16) & JP 04 061582 A (NIPPON TELEGR & TELEPH CORP), 27 February 1992 (1992-02-27) * abstract *	1-5	
			TECHNICAL FIELDS SEARCHED (InCL.7)
A	WO 95 03674 A (BRITISH TELECOMM ;MURPHY ANGELA RUTH (GB); GUNBY STEPHEN RICHARD ()) 2 February 1995 (1995-02-02) * abstract; claims *	1	H04N
A	US 4 498 104 A (SCHULZ AXEL) 5 February 1985 (1985-02-05) * abstract; claims *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11 January 2000	Examiner Foglia, P
CATEGORY OF CITED DOCUMENTS			
<p>X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document</p> <p>T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 30 6911

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-01-2000

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5488618	A	30-01-1996	JP	7087481 A	31-03-1995
US 5627590	A	06-05-1997	JP	5014392 A	22-01-1993
			CA	2073120 A,C	05-01-1993
			CA	2245053 A	05-01-1993
			DE	69225642 D	02-07-1998
			DE	69225642 T	12-11-1998
			EP	0521529 A	07-01-1993
			EP	0740471 A	30-10-1996
			US	5844628 A	01-12-1998
			US	5510839 A	23-04-1996
JP 02166892	A	27-06-1990	NONE		
JP 04061582	A	27-02-1992	JP	2877906 B	05-04-1999
WO 9503674	A	02-02-1995	AU	686198 B	05-02-1998
			AU	7192294 A	20-02-1995
			CN	1127578 A	24-07-1996
			DE	69413695 D	05-11-1998
			DE	69413695 T	18-03-1999
			EP	0710422 A	08-05-1996
			JP	9503890 T	15-04-1997
			NZ	268644 A	24-02-1997
			SG	47699 A	17-04-1998
			US	5745169 A	28-04-1998
US 4498104	A	05-02-1985	DE	3121599 A	23-12-1982
			JP	57203383 A	13-12-1982

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.